Wealth Inequality

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Macroeconomics III

Overview

- So far, we have studied idiosyncratic earnings risk.
- This risk maps into an ergodic distribution of earnings inequality.
- The distribution of earnings inequality implies an endogenous distribution of wealth inequality.
- Does our model imply a plausible distribution?
- Why do people save? Precautionary reasons? Life-cycle reasons?

Kuhn and Rios-Rull (2016)

The Idea

- Document the distributions of earnings, income, and wealth in the US.
- Date from the Survey of Consumer Finances.
- Sample of 6000 households oversampling the rich.
- Rich information on demographics.
- Focus on the household level.

Measures of Inequality

Authors consider three common measures of inequality:

- Gini coefficient.
- Coefficient of variation.
- The variance of logs.

These measures emphasize somewhat different types of inequality!

Gini coefficient

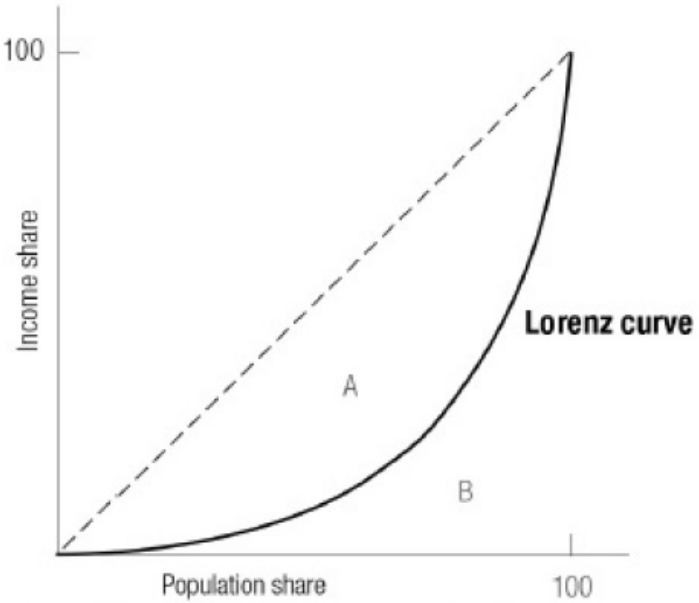


Figure 4. **Example of Lorenz curve for income.**

- Inequality measure based on the Lorenz curve.
- Divide area A by the area A + B.
- Zero implies perfect equality, one implies perfect inequality.
- Emphasize on part of distribution with most observations.

Coefficient of variation

$$G(\alpha) = \frac{1}{\alpha(\alpha - 1)} \sum \left(\frac{y_i}{\bar{y}} \right)^{\alpha} - 1$$

- The larger is α the more sensitive is it to the tails of the distribution.
- Choose $\alpha = 2$.
- Distributions have fat right tails. Emphasizes top inequality.

Variance of logarithms

$$VL = \frac{1}{N}\sum(log(y_i) - log(\bar{y}))^2$$

- Cannot handle non-positive values.
- Emphasizes bottom inequality.

Cross-sectional inequality

	Earnings	Income	Wealth
Coefficient of variation	3.69	4.19	6.81
Variance of logs	1.50	0.99	4.80
Gini indexes	0.67	0.58	0.85
Location of mean	70	74	83
99–50 ratio	17.46	14.78	96.81
90–50 ratio	4.15	3.33	11.56
Mean-to-median ratio	1.96	1.85	6.49
50–30 ratio	3.21	1.64	5.50

- No clear ordering between earnings and income inequality.

  Income reduces bottom inequality and increases top inequality.

- Wealth much more unequally distributed than income.

  Particularly at the top.

Income distribution

	Quintiles				
	1st	2nd	3rd	4th	5th
	Averages ($\times 10^3$ 2013 USD)				
Earnings	4.4	16	33.8	62.6	202.6
Income	13.1	28.3	47.1	78.4	265.1
Wealth	73.2	107.3	171.5	340.2	1949
	Income sources (%)				
Labor	30.9	53.4	67.2	75	60.4
Capital	−0.5	0.6	1.3	1.7	12.3
Business	3.1	3.8	5.2	5.5	18.1
Transfer	57.5	38.9	24.6	16.5	7
Other	8.9	3.2	1.7	1.3	2.3
	Portfolio shares (% of wealth)				
Housing and cars	71.7	78.9	67.5	58.6	25.7
Business and nonfinancial	19.9	17.1	19.5	24.5	37.4
Financial assets	31.0	33.7	46.8	48.5	49.3
Collateralized debt	−21.4	−28.2	−32.1	−30.3	−11.9
Uncollateralized debt	−1.2	−1.5	−1.7	−1.3	−0.5
	Age (%)				
Under 31	22.6	18.7	13.9	8.9	3.6
31–45	15.9	25.2	27.3	29.8	33.0
46–65	30.9	28.3	37.8	45.2	48.9
Over 65	30.6	27.8	21.0	16.1	14.5
Average (years)	52.4	51.2	50.5	50.5	51.2
	Education (%)				
Dropouts	24.3	17.1	8.5	3.9	1.1
High school	37.2	40	36.3	30.2	12.8
Some college	20.8	21.3	22.1	18.1	12.4
College	14.9	17.3	25.3	33.9	40.1
Postgraduate	2.8	4.3	7.7	13.9	33.7

Who are the income rich

- Significant income from capital and business.
- Have high wealth.
- Significant shares of business and financial wealth.
- Mostly college educated.
- Mostly married.

Who are the income poor

- Mostly labor income and transfers.
- Have very little wealth.
- Mostly housing wealth and some financial wealth.
- Significant uncolletarized debt.
- Few college educated.
- Large number of unmarried and single households with children.

Inequality in Aiyagari Economy

	Data	Model
Income 90/50	3.33	3.11
Income 50/30	1.64	1.65
Wealth 99/50	96.81	13.21
Wealth 90/50	11.56	7.05
Wealth 50/30	5.5	3.08

- Consider "extreme" calibration, all income inequality because persistent shocks.
- Model implies substantial wealth inequality in excess of income inequality!
- Not enough rich households compared to data.
- Not enough poor households compared to data.

Cagetti and De Nardi (2006)

Entrepreneurship and Wealth Distribution

Motivating facts:

1. Wealth distribution has fat right tail.

U.S. Wealth Distribution

	Fraction of People, Top			
	1%	5%	10%	20%
Total net worth held	30%	54%	67%	81%

Entrepreneurship and Wealth Distribution

Motivating facts:

2. Entrepreneurs are few, and hold a big portion of aggregate wealth in the US.

PERCENTAGE OF ENTREPRENEURS (According to Various Definitions) IN THE POPULATION AND CORRESPONDING SHARE OF TOTAL WEALTH HELD

	Percent in Population	Share of Total Wealth
Business owners or self-employed	16.7	52.9
All business owners	13.3	48.8
Active business owners	11.5	41.6
All self-employed	11.1	39.0
Self-employed business owners	7.6	33.0

Entrepreneurship and Wealth Distribution

Motivating facts:

3. Most rich people are entrepreneurs.

FRACTION (%) OF ENTREPRENEURS (According to Various Definitions) IN A GIVEN WEALTH PERCENTILE OF THE OVERALL U.S. WEALTH DISTRIBUTION

	WEALTH PERCENTILE, TOP			
	1%	5%	10%	20%
Business owners or self-employed	81	68	54	39
All business owners	76	62	49	36
Active business owners	65	51	42	30
Self-employed	62	47	38	26
Self-employed business owners	54	39	32	22

Entrepreneurship and Wealth Distribution

Motivating facts:

4. Entrepreneurs are much richer than nonentrepreneurs.

MEDIAN AND MEAN NET WORTH (in Thousands of Dollars) FOR VARIOUS GROUPS OF PEOPLE

	Median	Mean
Whole population	47	189
Business owners or self-employed	172	599
All business owners	205	695
Business owners but not active management	293	768
Business owners not self-employed	179	470
All self-employed	169	665
Self-employed (active) business owners	265	829
Self-employed and not business owners	36	224

Idea

Wealth allows to generate income because of financial constraints.
Questions:

- How severe are the financial constraints in the US? Can they account for the observed patterns (entry, exit, wealth distribution)?
- How do financial constraints affect capital accumulation and wealth inequality through entrepreneurial choices?

What do authors do?

- Build a life-cycle model of occupational choice, with retirement and bequests, to show that borrowing constraints decrease:
  - average firm size
  - number of entrepreneurs
  - capital accumulation

Model

- Life-cycle model with two phases of life, prob. of aging $1 - \pi_y$ if young, prob. of dying if old $1 - \pi_o$.
- There is retirement, altruism and bequests.
- Utility from consumption is CRRA: $\frac{c^{1-\sigma}}{1-\sigma}$, discount factor β for future consumption, η for utility of offspring.
- Stochastic persistent ability: for entrepreneurship θ, for salaried work y. Both!

Model

Two types of firms

- Entrepreneurial, operated by households: θk^{ν}
- Non-entrepreneurial, corporate: $AK^{\alpha}L^{1-\alpha}$.

Borrowing constraints

- Endogenous borrowing constraints, due to imperfect enforceability:
  - Entrepreneurs can shrink, become workers and enjoy a part of the borrowed amount, but creditors seize their wealth.
- So wealth acts as a collateral, and eases borrowing, hence entrepreneurship.
- Without imperfections, optimal capital only depends on ability. With imperfections, also on wealth.
- Hence, entrepreneurs have high implied returns on wealth.

Households' problem, young

$$V(a,y,\theta) = \max\{V_e(a,y,\theta), V_w(a,y,\theta)\}$$

where

$$V_e(a,y,\theta) = \max_{c,k,a'} u(c) + \beta E[\pi_y V(a',y',\theta') + (1-\pi_y) W(a',\theta')|y,\theta]$$

$$s.t.$$

$$c = \theta k^{\nu} + (1-\delta)k - (1+r)(k-a) - a'$$

$$u(c) + \beta E[\pi_y V(a',y',\theta') + (1-\pi_y) W(a',\theta')|y,\theta] \geq V_w(fk,y,\theta)$$

$$a' \geq 0,\ k' \geq 0$$

$$V_w(a,y,\theta) = \max_{c,a'} u(c) + \beta E[\pi_y V(a',y',\theta') + (1-\pi_y) W_r(a')|y,\theta]$$

$$s.t.$$

$$c = (1-\tau)wy + (1+r)a - a'$$

$$a' \geq 0$$

Households' problem, old

$$W(a,\theta) = \max\{W_e(a,\theta), W_r(a)\}$$

where

$$W_e(a,\theta) = \max_{c,k,a'} u(c) + \beta\{\pi_o E[W(a',\theta')|y,\theta] + (1-\pi_o)\eta E[V(a',y',\theta')]\}$$

$$s.t.$$

$$c = \theta k^{\nu} + (1-\delta)k - (1+r)(k-a) - a'$$

$$u(c) + \beta\{\pi_o E[W(a',\theta')|y,\theta] + (1-\pi_o)\eta E[V(a',y',\theta')]\} \geq W_r(fk)$$

$$a' \geq 0,\ k' \geq 0$$

$$W_r(a) = \max_{c,a'} u(c) + \beta\{\pi_o E[W_r(a')|a] + (1-\pi_o)\eta E[V(a',y',\theta')]\}$$

$$s.t.$$

$$c = p + (1+r)a - a'$$

$$a' \geq 0$$

Note: The ability of the offspring is drawn from unconditional dist.

Equilibrium

A stationary equilibrium is risk-free interest rate r, wage w, tax τ, allocations $c(a, y, \theta, s)$, $a(a, y, \theta, s)$, occupational choices, investments $k(a, y, \theta, s)$, and a constant dist. $m^*(a, y, \theta, s)$, s.t. given r, w and τ,

- Functions c, a and k solve the households' problem.
- Capital and labor markets clear:
  - Total capital used in entrepreneurial and nonentrepreneurial sector equals total wealth.
  - Labor used by the nonentrepreneurial sector equals the measure of workers.
- w and r equal the marginal product of the corresponding factor of production.
- Government budget balances: τ adjusts given p.

Calibration

- Common approach to calibration: Pick as many parameters as possible from literature or directly from data.
- Important: Those from the literature shouldn't be "very" sensitive to model novelties.

	Value	Source(s)
	A. Fixed Parameters	
σ	1.5	Attanasio et al. (1999)
δ	.06	Stokey and Rebelo (1995)
α	.33	Gollin (2002)
A	1.0	Normalization
π_y	.978	See text
π_o	.911	See text
$\mathbf{P}_y$	See text	Storesletten et al. (2004)
p	40% of average yearly income	Kotlikoff et al. (1999)
η	1.0	Perfect altruism

Calibration

- θ: Simplify to $[0, \bar{\theta}]$, hence one parameter.
- P_θ: Simplify to 2×2 matrix, hence two parameters.
- We also have ν, β, f.
- Six targets: capital-output ratio, fraction of entr., exit from entr., entry to entr., rel. net worth of entr., wealth Gini.

B. Calibrated Parameters

β	.865
θ	[0, .51]
$\mathbf{P}_\theta$	See text
ν	.88
f	75%

Do borrowing constraints matter

- Previous literature found that becoming an entrepreneur is not linked to ones wealth at low wealth levels.
- Simulate the model and estimate reduced-form relationship.
- The model implies a very similar reduced form relationship.
- Those with high ability will save to become an entrepreneur.
- Giving the poor one additional dollar is unlikely to push him beyond the entry threshold.

Results

- Wealth makes a high-ability individual become an entrepreneur.
- Saving rate of high ability workers is high.

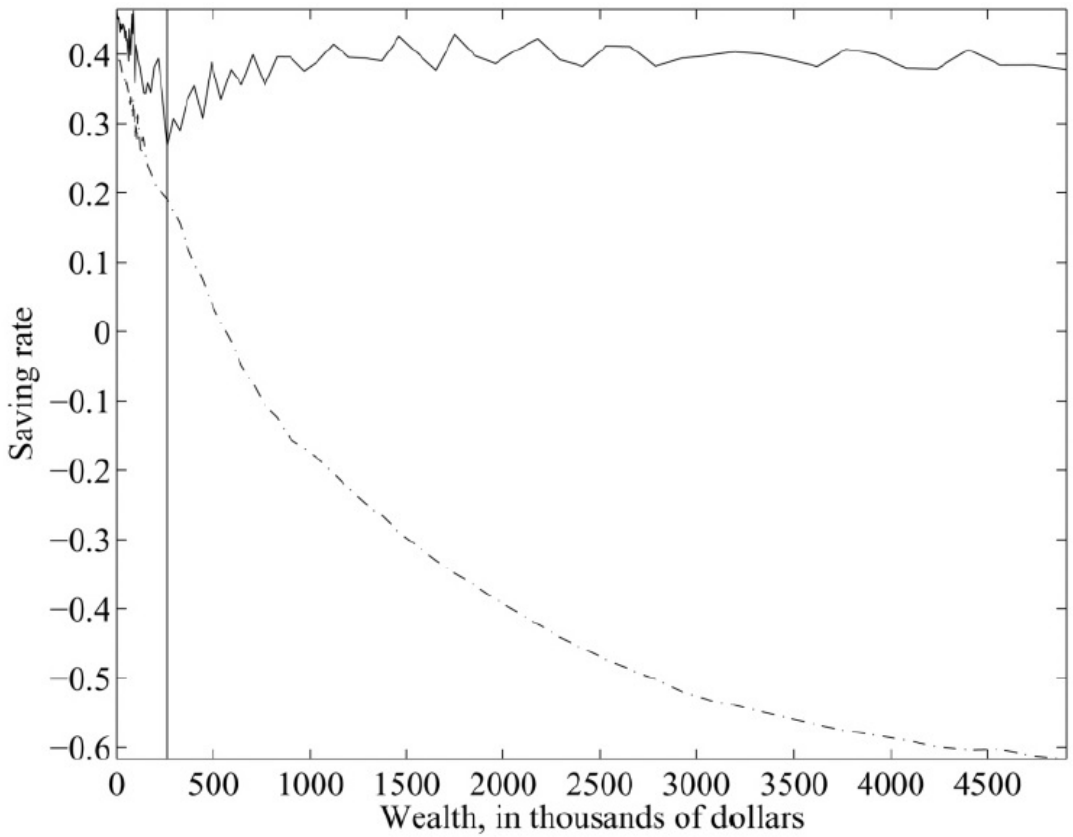


FIG. 5.—Saving rate for highest-ability workers. Solid line: those with high entrepreneurial ability; dash-dot line: those with no entrepreneurial ability; vertical line: asset level at which high–entrepreneurial ability individuals enter entrepreneurship.

Model performance

- Suppose you run an alternative exercise with uniformly-zero entrepreneurial ability.
- Entrepreneurship is an important channel for wealth concentration.

COMPARING DATA AND MODELS WITH AND WITHOUT ENTREPRENEURS

	CAPITAL-OUTPUT RATIO	WEALTH GINI	ENTREPRENEURS	PERCENTAGE WEALTH IN TOP			
				1%	5%	20%	40%
U.S. data	3.0	.8	7.55%	30	54	81	94
Baseline model without entrepreneurs	3.0	.6	.0%	4	20	58	95
Baseline model with entrepreneurs	3.0	.8	7.50%	31	60	83	94

Model performance

Caution I:

- We are using the simplified version of the baseline for comparison.
- This is not an impossibility result. One can still write a model to generate the wealth patterns without entrepreneurship.
- The take should be: In this framework, entrepreneurship helps.
- The take should not be: You need entrepreneurship to match the wealth concentration.

Caution II:

- Notice that Gini is a target in the baseline, not in the non-entrepreneurship alternative.

Model performance

- Overall wealth distribution is matched better with entrepreneurs.

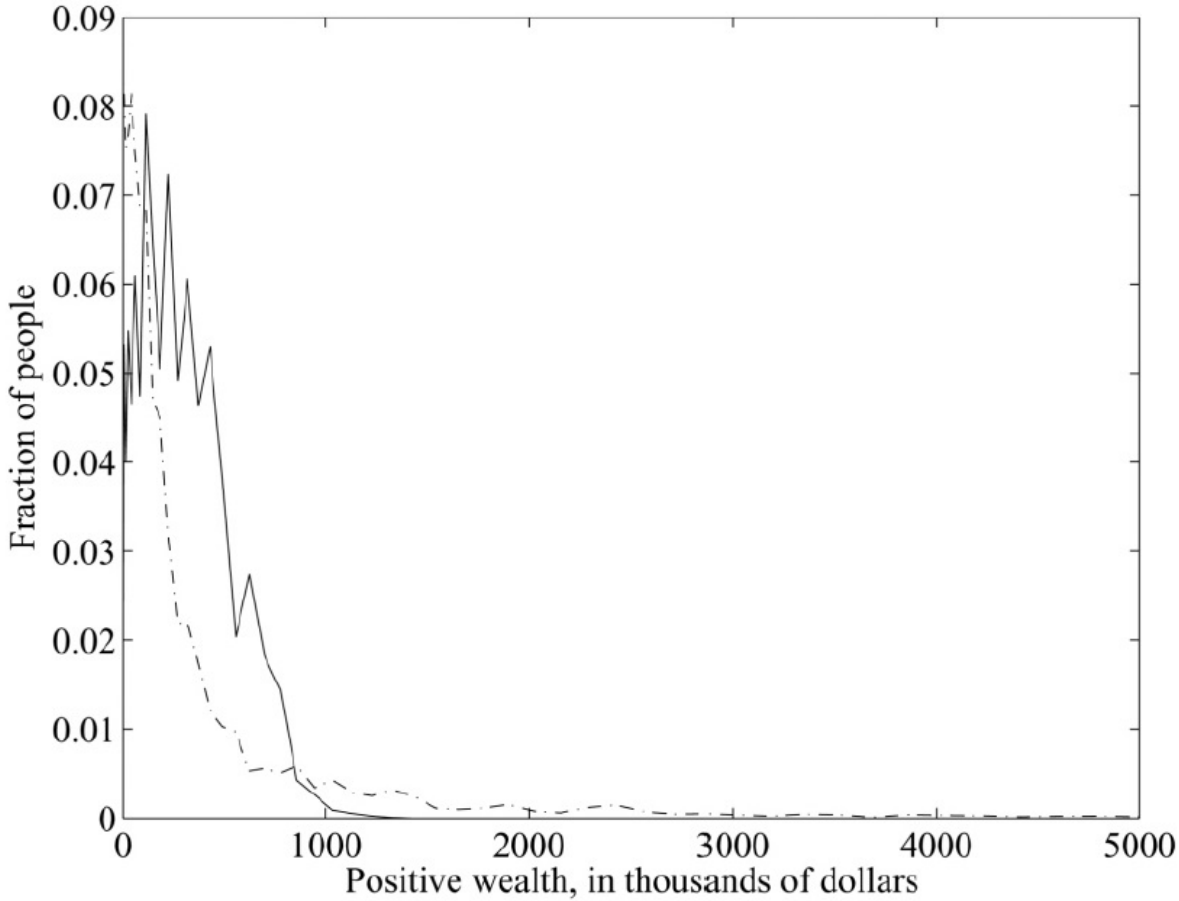


FIG. 1.—Distribution of wealth, conditional on wealth being positive, for the whole population. Dash-dot line: data; solid line: model without entrepreneurs.

Model performance

- Overall wealth distribution is matched better with entrepreneurs.

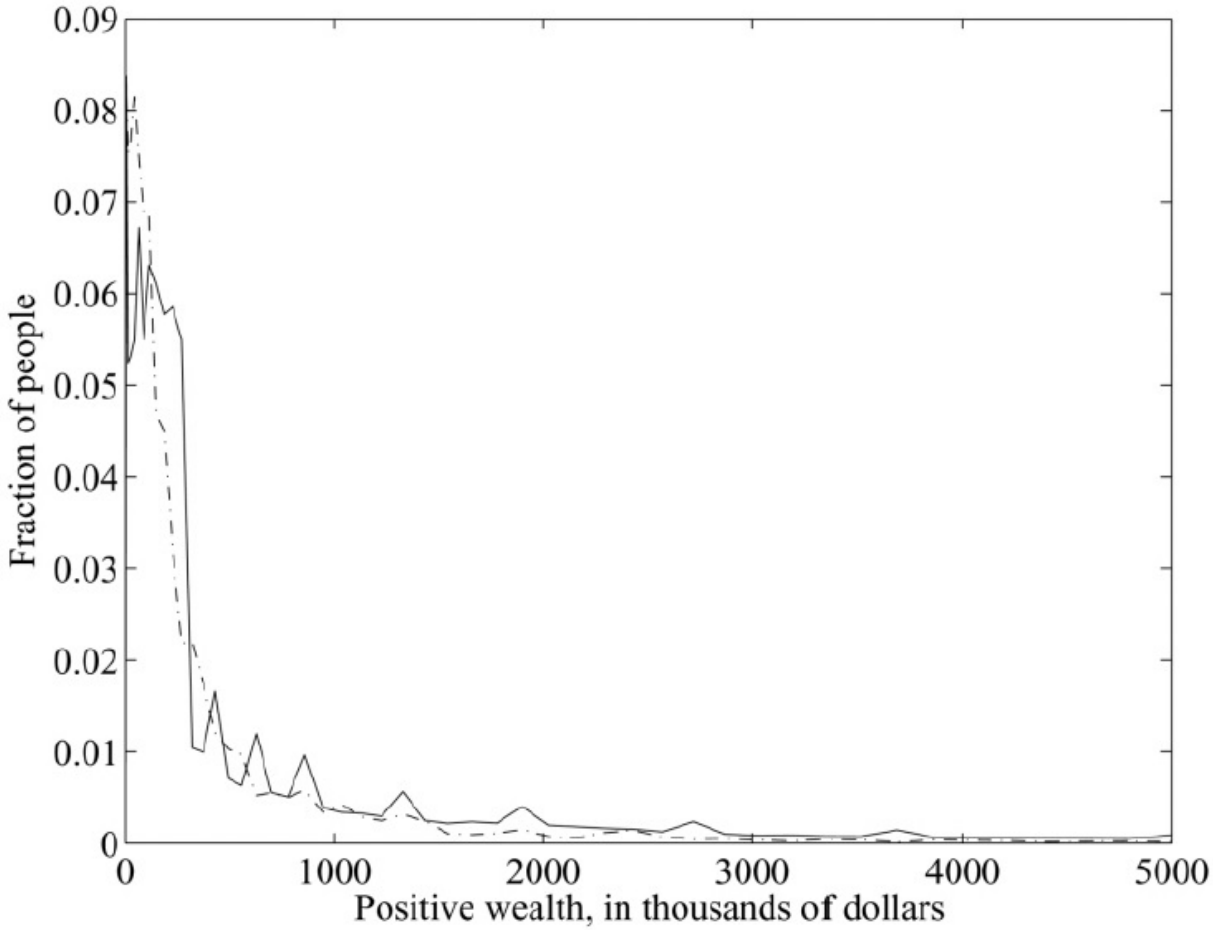


FIG. 2.—Distribution of wealth, conditional on wealth being positive, for the whole population. Dash-dot line: data; solid line: baseline model with entrepreneurs.

Model performance

- Entrepreneurial wealth distribution is matched well.

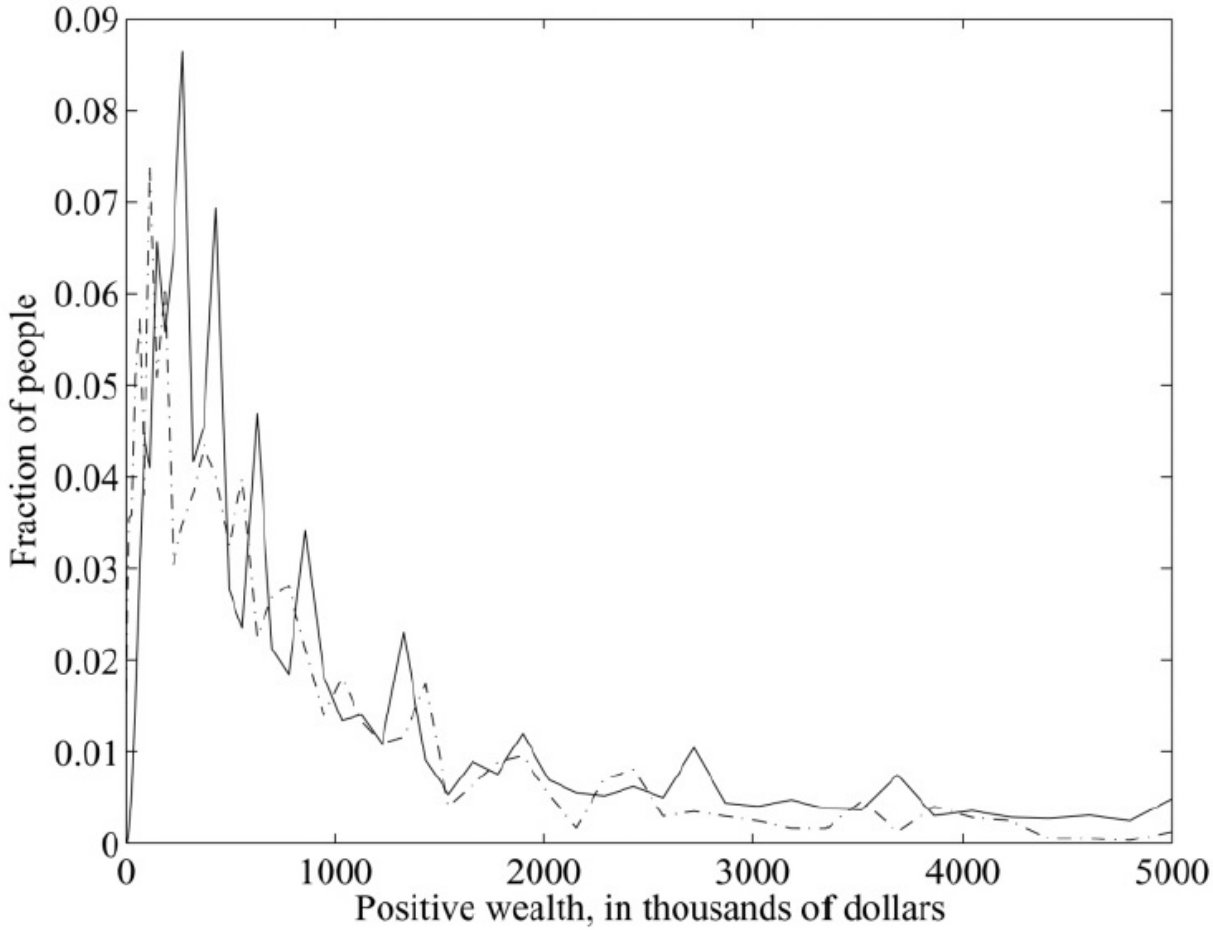


FIG. 4.—Distribution of the entrepreneurs' wealth, conditional on wealth being positive. Dash-dot line: data; solid line: baseline model.

Results

- Compare $f = 0.85$ instead of $f = 0.75$ (baseline).
- The more an entrepreneur can run away with, the more is the wealth accumulation.
- Higher wealth needed to start a project.
- Fraction of entrepreneurs drops and so does wealth inequality.

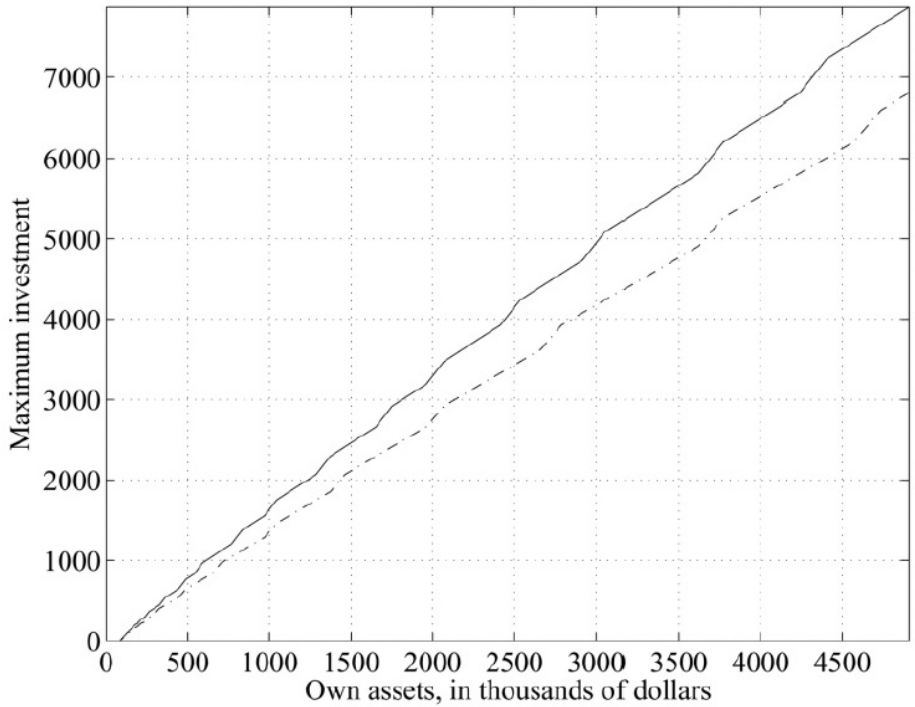


FIG. 7.—Maximum investment. Solid line: baseline; dash-dot line: more restrictive borrowing constraints.

Results

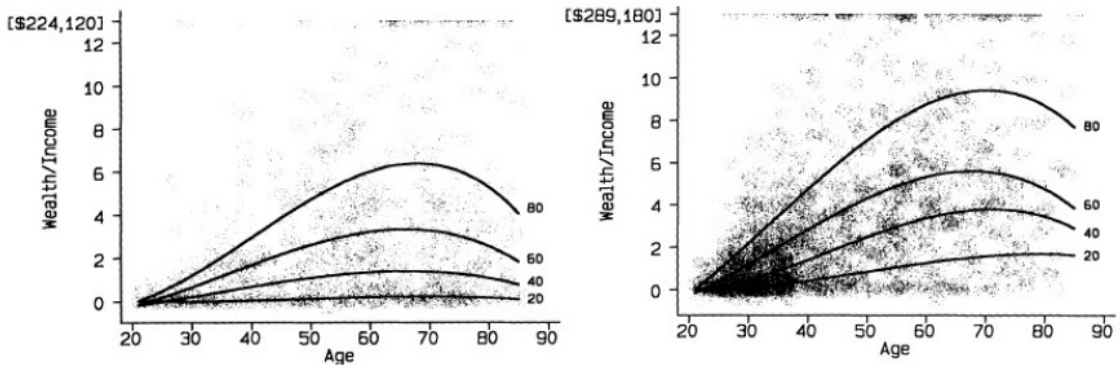
- Bequests increase total capital.
- Bequests increase inequality, through further accumulation of wealth.

THE ROLE OF BORROWING CONSTRAINTS AND VOLUNTARY BEQUESTS

	Capital-Output Ratio	Interest Rate	Wealth Gini	Entrepreneurs	Percentage Wealth in the Top			
					1%	5%	20%	40%
U.S. data	3.0	. . .	.8	7.55%	30	54	81	94
Baseline with entrepreneurs	3.0	6.5%	.8	7.50%	31	60	83	94
More stringent borrowing constraints: $f = .85$	2.7	7.5%	.7	6.90%	24	49	75	91
No altruism: $\eta = 0$, only involuntary bequests	2.5	9.3%	.7	7.55%	21	45	73	90
$\eta = 0$, recalibrated $\beta = .88$	3.0	6.4%	.8	7.9%	28	57	81	94

Hubbard et al. (1995)

Idea



- For college educated households, savings look similar to canonical model.
- Large fraction of high-school dropouts save close to nothing.

  Even close to retirement.

  50% hold less than 1/2 yearly income.
- Standard model: Wealth/income ratio is constant.

Possibilities

- High retirement replacement rates for low educated.
- Different income and health expenditure profiles.
- Lower income and health risk for low skilled.
- Government programs.

Model

Households maximize

$$E_t \sum_{s=1}^{T} \frac{D_s}{(1+\delta)^{s-t}} \frac{C_s^{1-\gamma} - 1}{1-\gamma}$$

$$A_s = A_{s-1}(1+r) + E_s + TR_s - M_s - C_s$$

$$A_s \geq 0$$

$$TR_s = max\{0, (\bar{C} + M_s) - [A_s(1+r) + E_s]\}$$

When resources are low, the government pays consumption floor, $\bar{C}$, and medical expenditure, M_s.

The Effect of Government Transfers

- The life-cycle interacts with transfers.
- Uncertainty interacts with transfers.
- To understand these mechanisms, let us consider simplified versions of the model.

2 Period Model, no Uncertainty

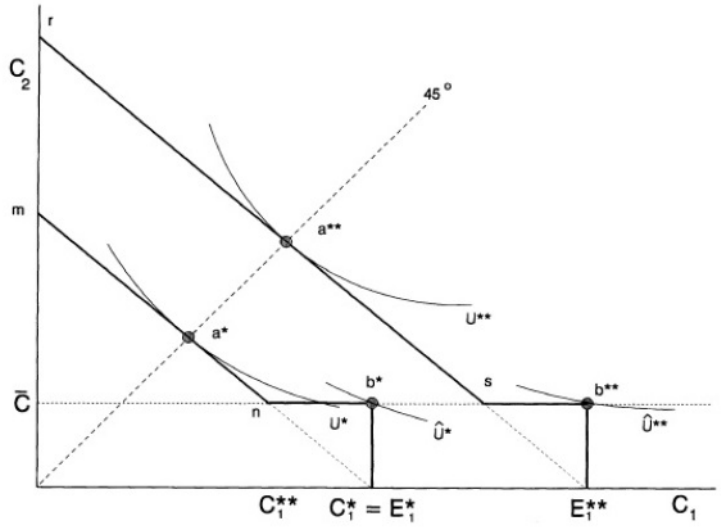
Assume $E_1 > \bar{C}$ and $E_2 < \bar{C}$ where E includes medical expenditure and E_1 initial assets.

$$\hat{C} = (E_1 - C_1)(1 + r) + E_2$$
$$C_2 = max\{\bar{C}, \hat{C}\}$$

Differentiating yields:

$$\frac{\partial C_2}{\partial C_1} = \begin{cases} 0 & \text{if } TR_2 > 0 \\ -(1 + r) & \text{otherwise} \end{cases}$$

2 Period Model, no Uncertainty



- With earnings E_1^*, budget constrained is $mnb^*E_1^*$.
- Choosing b^* is preferred to a^*.
- With earnings E_1^{**}, budget constrained is $rsb^{**}E_1^{**}$.
- Choosing a^{**} is preferred to b^{**}.
- More income (wealth) may lead to less consumption.

2 Period Model, with Uncertainty

Two income states realizing with equal probability: high, E_{2g}, and low E_{2b}. Let Q_{2g} be an indicator function that is one if the household chooses to save so little that in the good state it will receive transfers:

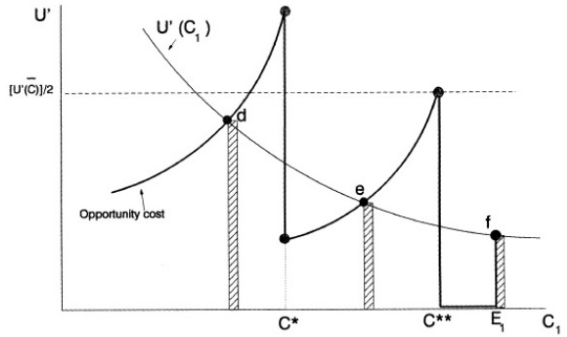
$$max_{C_1}\Big\{U(C_1)+\frac{1}{2}U\Big((E_1-C_1+E_{2g})(1-Q_{2g})+\bar{C}Q_{2g}\Big) + \frac{1}{2}U\Big((E_1-C_1+E_{2b})(1-Q_{2b})+\bar{C}Q_{2b}\Big)+\mu_1(E_1-C_1)\Big\}$$

Differentiating yields

$$U'(C_1)=\frac{1}{2}\Big[U'(C_{2g})(1-Q_{2g})+U'(C_{2b})(1-Q_{2b})\Big]+\mu_1.$$

Call the right-hand-side the opportunity costs of consumption today.

2 Period Model, with Uncertainty

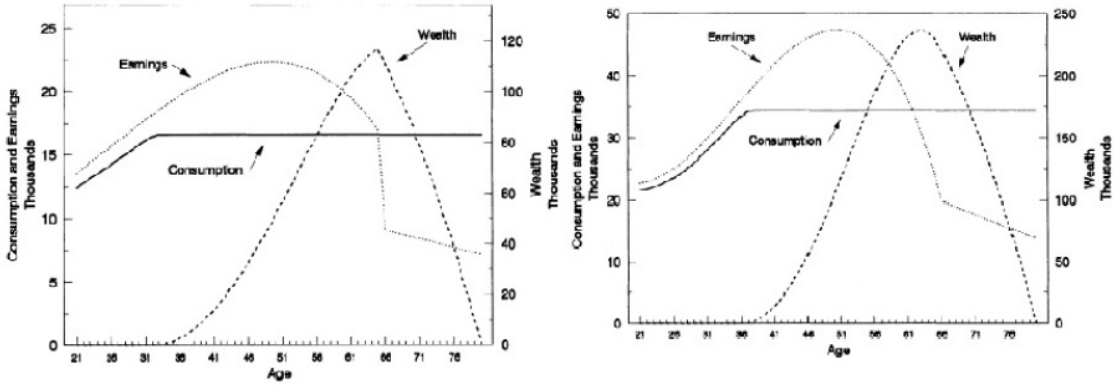


- Initially, more consumption today decreases consumption both in the good and the bad state. At point d: Never welfare.
- At C^*: Savings lead to $\bar{C}$ in the bad state. The opportunity costs decrease as more consumption today only affects consumption tomorrow in the good state.
- Point e: Welfare in bad state but not in the good state.
- C^{**}: Savings lead to $\bar{C}$ in good state. No incentives to save.
- Point f: Welfare in all states. $C_1 = E_1$.

Full Model: Calibration

- Set $\gamma = 3$ and $r = 0.03$.
- Mortality probabilities for females.
- Estimate persistent earnings shocks in the data by skill.
- Estimate persistent health shocks in the data by skill.
- Consumption floor includes *AFDC*, *food stamps*, *Section 8 housing*, and *SSI*. Leads to \$7000.

Result: No Risk



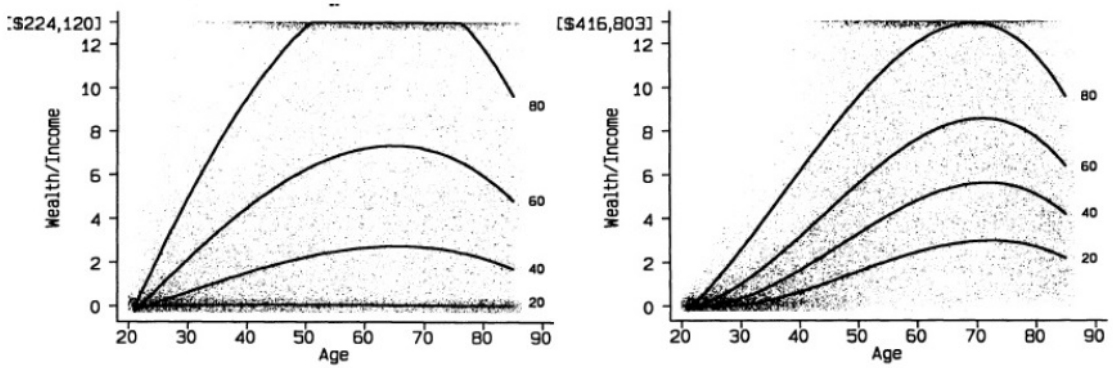
- Let us start with a model without risk to understand the role of differences in average life-cycle profiles.
- Similar life-cycle profiles across education groups.
- Hence, average earnings and expenditure differences do not matter.

Result: Small Welfare State

Age and Education	Actual (PSID) (1)	Simulated $1,000 Consumption Floor (2)
< 30:		
No high school	86.3	43.7
College	74.9	90.8
30–39:		
No high school	68.3	8.0
College	38.4	49.8
40–49:		
No high school	50.7	3.7
College	22.9	11.0
50–59:		
No high school	30.0	1.6
College	4.6	.5
60–69:		
No high school	29.6	2.3
College	.4	.5
70–80:		
No high school	25.0	.5
College	.0	.0

- Now we introduce risk to understand possible differences in the risk processes across education groups.
- Similar amount of low wealth households across education groups.
- Particularly close to retirement we see little differences.

Result: Full Model



- Finally, let us introduce the welfare state.
- College workers accumulate high savings.
- Large fraction of high school dropouts with close to zero wealth.
- Too high wealth holdings of 40-60 percentile.

References

Cagetti, M. and M. De Nardi (2006): "Entrepreneurship, Frictions, and Wealth," *Journal of Political Economy*, 114, 835–870.

Hubbard, G. R., J. Skinner, and S. P. Zeldes (1995): "Precautionary Savings and Social Insurance," *Journal of Political Economy*, 103, 360–399.

Kuhn, M. and V. Rios-Rull (2016): "2013 Update on the U.S. Earnings, Income, and Wealth Distributional Facts: A View from Macroeconomic Modelers," *Federal Reserve Bank of Minneapolis Quarterly Review*, 37.